ModHopper® – Wireless Modbus/Pulse Transceiver

Obvius, LLC

Installation and Operation Manual

Model R9120 (Rev C)

Date Dec 11, 2012

1.800.561.8187 www.itm.com information@itm.com

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Product Application Limitation

Obvius strongly believes in continuous improvement, therefore we must reserve the right to change specifications and product offerings without notice. Where possible, we will substitute products with equivalent functionality when necessary.

NOTICE

- This product is not intended for life safety applications.
- Do not install this product in hazardous or classified locations.
- The installer is responsible for conformance to all applicable codes.

FCC Part 15 Information

Note: This equipment has been tested by the manufacturer and found to comply with the limits of a class A digital device, pursuant to part 15 of the FCC rules. These limits are designed to provide reasonable protection against interference when the equipment is operated in a commercial environment. This equipment generates, uses, and can radiate radio frequency energy and, if not installed and used in accordance with the instruction manual, may cause harmful interference to radio communications. Operation of this equipment in a residential area is likely to cause harmful interference in which case the user will be required to correct the interference at his own expense. Modifications of this product without the express authorization of Obvius nullify this statement.

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Markings and Symbols:

WARNING: A potential risk exists if the operating instructions are not followed

General Warning Symbol: This symbol indicates the need to consult the operating instructions provided with the product.

This symbol indicates the presence of electric shock hazards.

This symbol indicates: Do not apply to or remove from hazardous live conductors.

⎓ Direct Current symbol.

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Overview

The ModHopper™ wireless Modbus/pulse transceiver is designed to allow systems integrators the ability to communicate with remote locations while avoiding the costs associated with running low voltage wiring to multiple locations in a single or between multiple buildings. To meet these requirements, the ModHopper™ provides the installer with all the tools necessary to install and configure the hardware and software with a minimum of time and investment.

Applications

The R9120 wireless Modbus/pulse transceiver has several applications. These include:

- Energy Monitoring.
- Solar PV Power Generation monitoring
- Malls, office buildings, and other tenant energy monitoring applications.

Installation Checklist

A ModHopper™ system installation has the following components:

Required hardware

- Two or more ModHopper R9120 transceivers.
  Note: the R1920 transceivers must be the same radio type. e.g. R9120-3 must be used with another R9120-3; R9120-5 must be used with another R9120-5.

External hardware

- RS485 Modbus master system such as an A8812 AcquiSuite™ or a Modbus compatible PLC.
- Optional: RS485/Modbus slave devices such as power meters or IO modules.
- Optional: Pulse output transducers for measuring gas, electricity, water, etc. from existing meters and sensors. Make sure to obtain the pulse output scale, or multiplier for each device you will be using.
- Low voltage wire for attaching pulse or Modbus devices to the R9120, typically 18-24gauge

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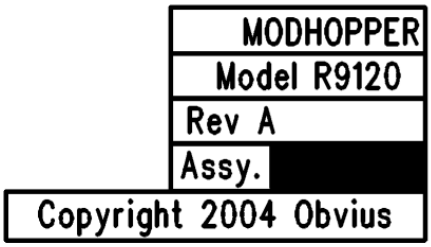
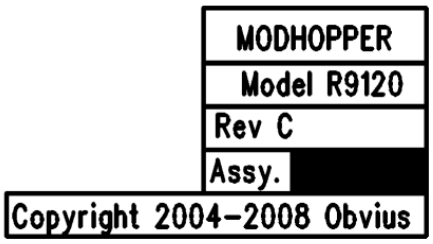
Model Information

There are two revisions of the ModHopper R9120 hardware board. These are Rev-A and Rev-C. Below is a picture of the revision information on the circuit board. This is located next to the screw terminals on the board.





Before proceeding with the installation, verify the hardware is Rev C. If you have the Rev-A marking on the circuit board, please download the user manual for the Rev-A hardware. It is important to use the correct manual that matches the hardware being installed.

This manual covers only revision C hardware.

As per SIPCO LLC, this product may be used in a system and employ or practice certain features and/or methods of one or more of the following patents:

SIPCO, LLC
U.S. Patent No. 7,103,511
U.S. Patent No. 6,914,893
U.S. Patent No. 6,891,838
U.S. Patent No. 5,714,931
U.S. Patent No. 6,233,327
U.S. Patent No. 7,397,907
U.S. Patent No. 6,618,578
U.S. Patent No. 7,079,810
U.S. Patent No. 7,295,128
U.S. Patent No. 7,263,073
U.S. Patent No. 7,480,501
U.S. Patent No. 6,437,692
U.S. Patent No. 7,468,661
U.S. Patent No. 7,053,767
U.S. Patent No. 7,650,425
U.S. Patent No. 7,739,378

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Hardware Overview

R9120 Features and Specifications

Processor	60MHz Arm7 embedded CPU
LED	3 x RF, 2 x RS 485, 2 x pulse, Alive, Alarm
Protocol	Modbus RTU
Addressing	Modbus address may be set from 1 to 247 via Dipswitch.
Power Supply[1,3]	Included class 2 power supply requires 110-120VAC (power supply not included in models with -T option)
Inputs[2]	2 pulse inputs, dry contact Monitor consumption/rate/min/max Pulse rate/width user selectable to 10Hz, 50Hz, 100Hz, or 250Hz. Pulse rate option: 10Hz, minimum pulse width 50ms Pulse rate option: 50Hz, minimum pulse width 10ms Pulse rate option: 100Hz, minimum pulse width 5ms Pulse rate option: 250Hz, minimum pulse width 2ms Contact closure threshold 100Ω to 2.5kΩ user selectable Pulse count values are stored in non-volatile memory.
Communications[1]	RS-485 (+,-, S), 9600/19200 baud, N, 8, 1, two wire. Supports up to 32 external devices per ModHopper. (expandable)
RF	Frequency Hopping, ISM band, see table below. -SN option: 400MHz receive only (sensor network)
Environmental[2]	North America: Temperature 0º – 50ºc [3], 0 – 95% humidity, non-condensing. Pollution Degree 2, Altitude up to 2000M. For indoor and outdoor use when used in an appropriate enclosure. The R9120 must be mounted inside a NEMA rated electrical enclosure for safety and isolation requirements when used outdoors.
EMC	FCC CFR 47 Part 15, Class A
Size	6.5” x 4.5” x 2” (260mm x 64mm x 45mm)
Mass	1.25 lbs (0.67 kg)

Product specific features:	R9120-1 (low power)	R9120-3 (high power)	R9120-3AU (high power)	R9120-5 (extended range)	R24120-3 (high power)
FCC ID	OUR-9XCITE	OUR9XTREAM	OUR9XTREAM	OUR-9XTEND	OUR-24XTREAM
IC (Industry Canada)	4214A-9XCITE	4214A-9XSTREAM		4214A-9XTEND	4214A 12008
Encryption	No	No	No	256bit AES	No
Max Range (indoor/urban)	100-300ft	1500ft	1500ft	3000ft	300ft
RF:	900MHz, 1mW	900MHz, 100mW	900MHz, 100mW Australia/NZ	900MHz, 1000mW	2.4GHz, 50mW
Power Input[3]	9-30VDC, 200mA	9-30VDC, 200mA	9-30VDC, 200mA	9-30VDC, 900mA	9-30VDC, 200mA

[1] Intended for low voltage class 2 inputs or outputs.

[2] If the product is used in a manner not specified by the manufacturer, the protection provided by the equipment may be impaired.

[3] Not intended for use with rechargeable batteries.

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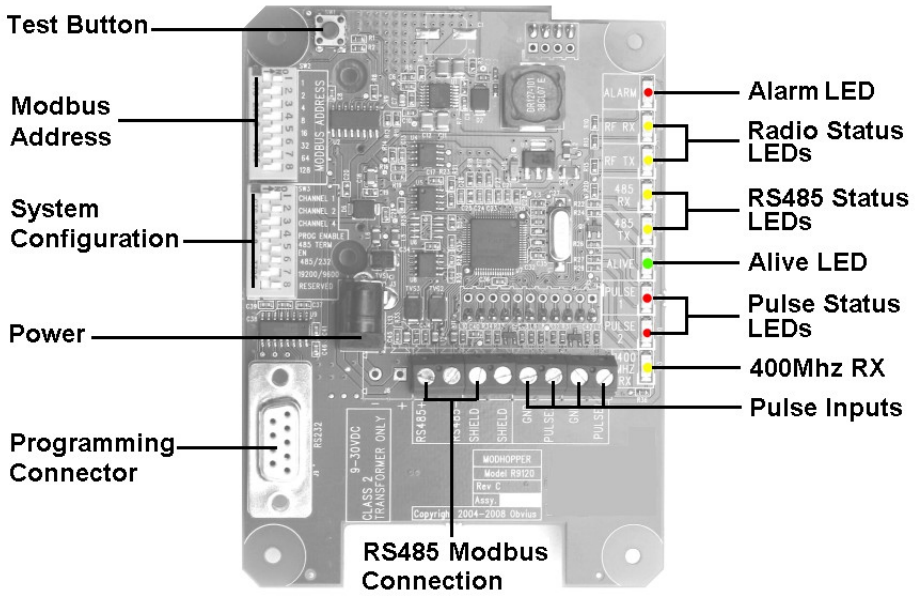
Electrical Connections



Hardware Installation

Step 1 - Unpack materials: Remove all materials from shipping box and verify all required components are available

Step 2 - Mount the ModHopper to a wall or inside the electrical enclosure if required. When mounting the ModHopper and the antenna inside an enclosure, a non-metallic enclosure will be required. Metal enclosures restrict RF communications. If a metal enclosure is required, use an external antenna and an RF antenna cable.

Step 3 - Connect the pulse output devices. For KYZ pulse output meters, attach the normally-open circuit to the ModHopper. These are usually the K and Z terminals.

Step 4 - Connect the RS485 Modbus network loop as shown in the wiring diagram. Follow the manufacturer's instructions for installing and powering other Modbus devices. Verify that the Modbus address settings are unique for each device (i.e., no two devices with the same address). Connect each device in the chain by "daisy-chaining" the devices together . Observe + and - polarity on the Modbus devices. For more information about Modbus loops, please read our Modbus FAQ available at www.obvius.com.

Do not ground the RS485 shield inside an electrical panel. All RS485 and 24VDC power wires, including the shield should be insulated to prevent accidental contact to high voltage conductors.

The pulse, RS485 and power cable should be mechanically secured where it enters the electrical panel.

The wire used to provide pulse and RS485 communications should be insulated to meet requirements of the voltages present inside any box the wire is mounted within. For example, Belden 1120A has a 600v insulation rating and can be used in many applications. Check with your electrical installer for details as local code requirements may vary.

WARNING: After wiring the ModHopper, remove all scraps of wire or foil shield from the electrical panel. This could be dangerous if wire scraps come into contact with high voltage wires.

Step 5 – Attach the antenna to the ModHopper. When using an antenna cable, avoid sharp bends; kinks in the antenna cable will degrade performance.

Step 6 – Attach the power to the ModHopper and apply power. Observe the LEDs to confirm the device is operating.

- **Alive (green):** blinks once per second while the system is operating correctly.
- **RS485 RX:** The RX led should blink whenever a modbus query is sent on the RS485 loop. (regardless of the target address of the query). If the ModHopper is attached to an AcquiSuite, the RX led should blink about once per second.
- **RS485 TX**: The TX LED will blink when the A89DC-08 responds to a modbus query.

Note: If cleaning is required, use a dry towel to remove dust from the ModHopper. Do not use fluids to clean the ModHopper.

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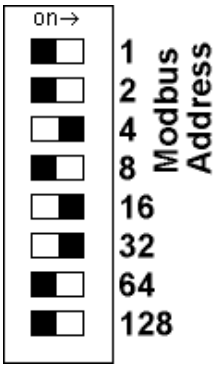
Modbus Address



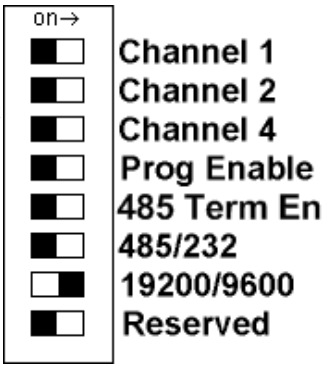
Before the ModHopper can be used, you must set the Modbus address of the ModHopper. This address must be unique among all Modbus devices in the system including all devices that are connected on remote wireless links. Address 0 (all switches off) is not allowed.

Select an address, and set the dipswitches to match.

The sum of the value of the switches is the address. In the example to the right, address 52 is set by placing switch 4, 16 and 32 to the on position.

Note: 4 + 16 + 32 = **52**

System settings



For most systems, set all of the system switches to the "off" position.

Radio channel: This option selects the channel number that can be used to isolate a group of ModHoppers. This option may be set for channels 0 to 6. Channel 7 (all 3 switches on) is not allowed.

Programming: Set the "Prog Enable" to Off for normal operation.

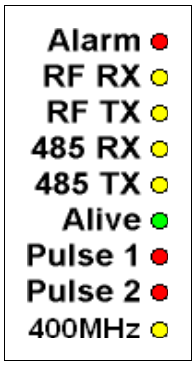
485 Termination Enable: Set the "485 Term En" to ON to enable a 120ohm termination resistor on the RS485 network. This should be used when the ModHopper is on the end of a 485 wiring run. Set this switch to OFF when the ModHopper is in the middle of an RS485 wiring run.

Port RS232 or RS485: Set the switch to the "off" position for RS485 operation. The ModHopper can communicate via the RS232 connection however most Modbus devices will need 485 terminals. .

Baud Rate: This option sets the serial port speed for the Modbus devices connected to the ModHopper. Set this option to "off" for 19200. Set the switch to "on" for 9600 baud.

Reserved: Set this option to Off.

Status LEDs



The device should power up and be ready in a few seconds. The LEDs should blink in the following manner.

- The "Alive" LED should start to blink about once per second.
- The Alarm LED will blink when transmission errors occur.
- The RF TX/RX LEDs will blink when the radio is receiving or transmitting data.
- The RS485 LEDs will blink for local Modbus activity.
- The Pulse input LEDs will light when the corresponding pulse input terminals are closed.
- If the device has the -SN option, the 400MHz LED will blink when an RF packet from a 400MHz sensor transmitter is received.

Signal Strength Test

When the ModHopper is operating, the Test Button can be used to report the signal strength received by the ModHopper from another unit.

Press and hold down the test button. The status LEDs will light up as a bar graph display. Each LED is approximately 10% of scale. For example if PULSE 1 and 2 are on, the received strength is approximately 20% to 29%.

For useful signal reporting, it is important to turn off all but one other ModHopper. When reporting the signal strength, the most recent wireless transmission received is displayed. If two ModHoppers are transmitting, the display will only show the most recently received packet, and the user will not be able to determine which ModHopper the signal strength being reported.

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Note: the normal operation of the ModHopper is suspended while the test button is pressed. Modbus communications and wireless transmissions are not processed.

Monitoring usage:

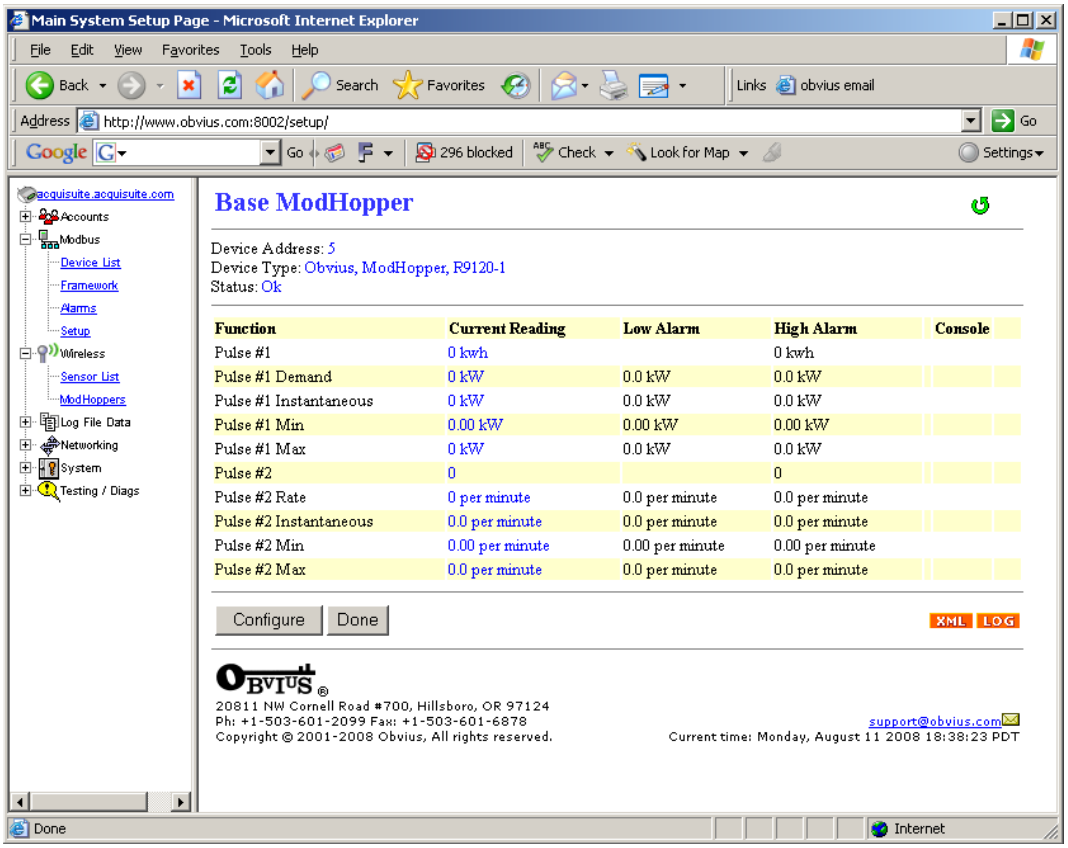
The ModHopper has several data points that may be read using the Modbus protocol.

For each of the two pulse inputs, the ModHopper reports a value for consumption and rate. Rate fields are provided for the average rate during the log period (block demand), the instantaneous rate, and the min/max instantaneous rate observed during the log period. The pulse counts for each input are stored in non-volatile memory to preserve the count when power is removed. For more information on the specific Modbus registers used for the pulse inputs, refer to the Modbus register section of this manual.

When configuring a Modbus Master such as a PLC, TCP Gateway, or computer software, you must increase the timeout on the RS485 port of your system. The ModHopper adds about 500mS of delay per hop. In a complex system with multiple ModHoppers, a 1 to 2 second round trip time is not uncommon.

AcquiSuite Data Display Page:

When using the ModHopper with the AcquiSuite data acquisition server, the AcquiSuite will read the pulse input data from the ModHopper and provide configuration menus for all of the ModHopper options.


Main System Setup Page - Microsoft Internet Explorer
File Edit View Favorites Tools Help
Back Search Favorites Links obvius email
Address http://www.obvius.com:8002/setup/
Go
Google Go 296 blocked Check Look for Map Settings
acquisuite.acquisuite.com
Accounts
Modbus
Device List
Framework
Alarms
Setup
Wireless
Sensor List
ModHoppers
Log File Data
Networking
System
Testing / Diags
Base ModHopper
Device Address: 5
Device Type: Obvius, ModHopper, R9120-1
Status: Ok
Function | Current Reading | Low Alarm | High Alarm | Console
Pulse #1 | 0 kwh | | 0 kwh
Pulse #1 Demand | 0 kW | 0.0 kW | 0.0 kW
Pulse #1 Instantaneous | 0 kW | 0.0 kW | 0.0 kW
Pulse #1 Min | 0.00 kW | 0.00 kW | 0.00 kW
Pulse #1 Max | 0 kW | 0.0 kW | 0.0 kW
Pulse #2 | 0 | | 0
Pulse #2 Rate | 0 per minute | 0.0 per minute | 0.0 per minute
Pulse #2 Instantaneous | 0.0 per minute | 0.0 per minute | 0.0 per minute
Pulse #2 Min | 0.00 per minute | 0.00 per minute | 0.00 per minute
Pulse #2 Max | 0.0 per minute | 0.0 per minute | 0.0 per minute
Configure Done
XML LOG
OBVIUS
20811 NW Cornell Road #700, Hillsboro, OR 97124
Ph: +1-503-601-2099 Fax: +1-503-601-6878
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support@obvius.com
Current time: Monday, August 11 2008 18:38:23 PDT
Done
Internet

The AcquiSuite will display will report all the data values present on the ModHopper. In addition, the instantaneous min/max rate values will be cleared after each logging interval. Click the Configure button to set up pulse input names, unit of measure and multipliers as needed.

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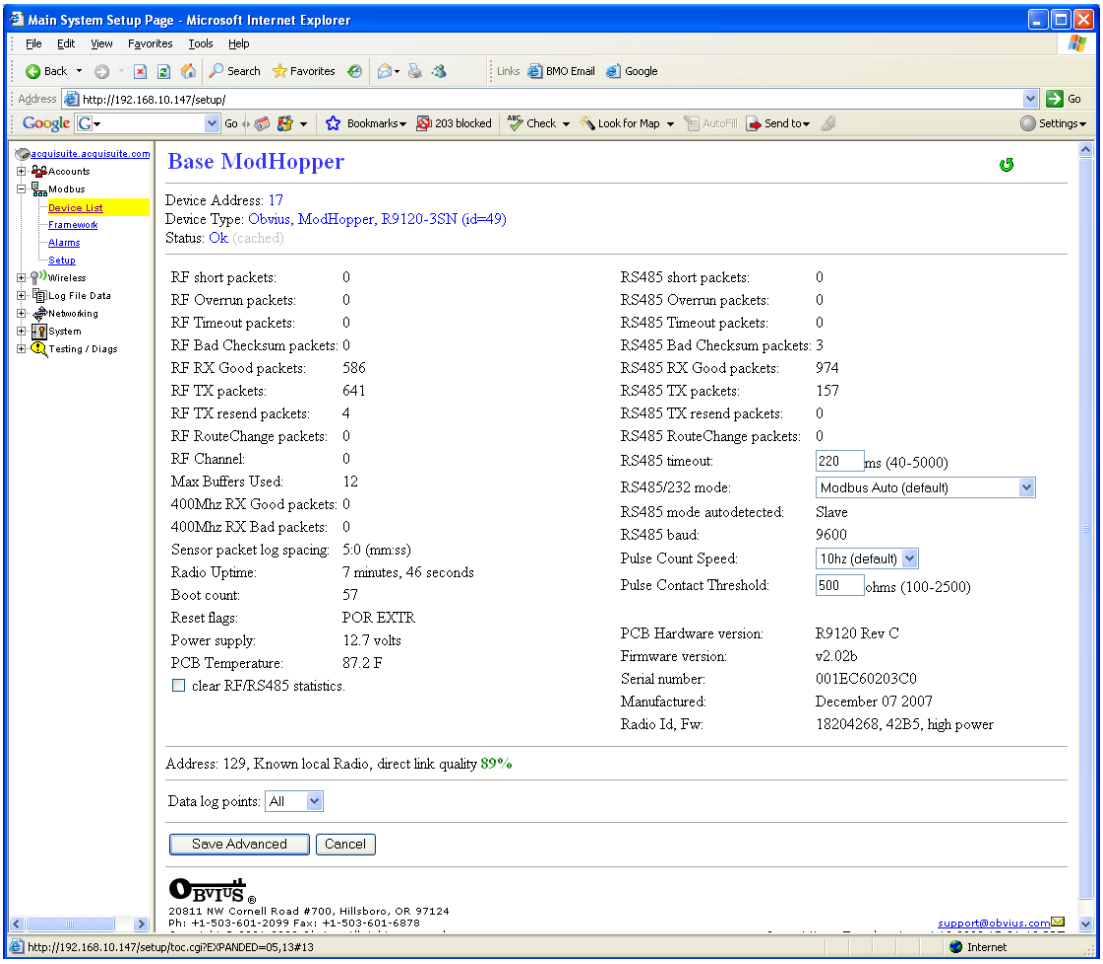
AcquiSuite Advanced Configuration Options

The AcquiSuite setup and configuration page includes an advanced configuration page to set all of the ModHopper features with a convenient web page interface. Below is an example screen for the AcquiSuite advanced configuration page.



In this setup page, there are several options available.

- Serial port timeout, and protocol configuration. When a request comes in over the wireless mesh network and is sent out on the ModHopper RS485 serial port, the ModHopper must wait for the attached modbus device to reply to the query. The timeout option controls how long the ModHopper will wait before giving up on the attached Modbus device and discarding the query. Most Modbus devices will respond in 150ms or less.
- Pulse input contact closure threshold: allows you to set a maximum resistance to be counted as a "closed" contact. This is helpful when using intrinsic barrier devices. Default of 500 ohms will work in most applications.
- Pulse input maximum count frequency. For most pulse meters, 10Hz is adequate. Faster counting of mechanical relays may result in "relay bounce" and give an incorrect count. Consult the pulse output device for information on maximum expected pulse output rate.
- Data log control: enable/disable AcquiSuite data logging for the ModHopper. Note: this is an internal AcquiSuite feature, and does not set any registers on the ModHopper.

In addition to the configuration options, some further details about the ModHopper are provided These include the serial number, firmware version, uptime, RF/RS485 packet counters, and internal temperature and power supply monitor.

For further information configuration and status registers, refer to the Modbus section in this manual.

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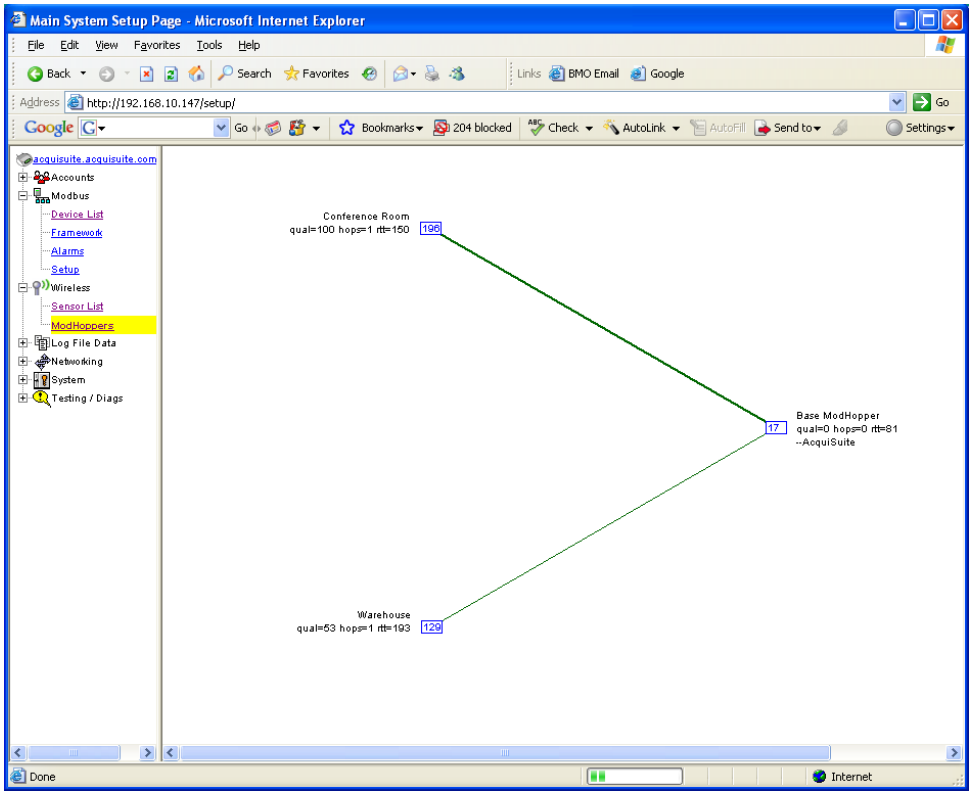
AcquiSuite route mapping display

The AcquiSuite data acquisition server has additional diagnostic features that assist with ModHopper deployments. The most useful is the ModHopper route map. Select the ModHoppers menu from the Wireless section in the AcquiSuite menu tree as shown below.



The graph will draw a blue box for each ModHopper that is attached to the system. The blue number inside the box icon is the Modbus address of the ModHopper. To the side of each icon, three lines of information will be shown.

- The device list name will be shown to the side of each ModHopper icon
- The link quality, hops and round trip time (rtt) will be printed under the ModHopper name.
- A list of attached Modbus device addresses will be shown on the third line. This is a list of addresses that the ModHopper has automatically detected on the local RS485 port.

The graph will print strong links in thick green lines. Lines progress from green, to yellow, to red to indicate weak links.

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Modbus Features

Supported Modbus Functions

The R9120 device responds to the following Modbus query functions:

0x11 Report slave id.

0x03 read holding registers (multiple)

0x06 preset single register

These should be sufficient to perform all operations (read many values, make single change, and identify). In addition the device will respond to with Modbus exceptions for invalid function, value, and register if out of bound requests are made.

Modbus function 0x11 Slave ID function will respond with id=49 and one of the following id text values:

"Obvius, ModHopper, R9120-1"
"Obvius, ModHopper, R9120-3"
"Obvius, ModHopper, R9120-3T"
"Obvius, ModHopper, R9120-3SN"
"Obvius, ModHopper, R9120-3SNT"
"Obvius, ModHopper, R9120-3AU"
"Obvius, ModHopper, R9120-3AUT"
"Obvius, ModHopper, R9120-5"
"Obvius, ModHopper, R9120-5T"
"Obvius, ModHopper, R24120-3"
"Obvius, ModHopper, R24120-3T"
"Obvius, ModHopper, R24120-3SN"
"Obvius, ModHopper, R24120-3SNT"

Modbus Register List

All modbus registers are read-only unless otherwise noted.

Data points:

offset	point	type	desc
0	40001	UINT32	(N/V) pulse count 1 MSW
1	40002	UINT32	(N/V) pulse count 1 LSW
2	40003	UINT32	(N/V) pulse count 2 MSW
3	40004	UINT32	(N/V) pulse count 2 LSW (same format as pulse count 1)
4	40005	UINT16	inst pulse 1 time (seconds)
5	40006	UINT16	inst pulse 2 time (seconds)
6	40007	UINT16	(R/W) min pulse 1 time (seconds) (write clears min/max)
7	40008	UINT16	(R/W) min pulse 2 time (seconds)
8	40009	UINT16	(R/W) max pulse 1 time (seconds)
9	40010	UINT16	(R/W) max pulse 2 time (seconds)
10	40011	UINT16	(R/W, N/V) inst pulse count size. (default 5)
100	40101	UINT16	Serial Number (bytes 1,2) (serial number)
101	40102	UINT16	Serial Number (bytes 3,4)
102	40103	UINT16	Serial Number (bytes 5,6)
103	40104	UINT16	firmware version (e.g. v1.03, high byte=major, lowbyte=minor, 0x8000 flag set for Beta)
104	40105	UINT16	boot count
105	40106	UINT32	mfg date MSW
106	40107	UINT32	mfg date LSW
107	40108	UINT16	radio group id setting (0-6)
108	40109	UINT16	alarm flags (0x01 = boot from watchdog)
109	40110	UINT16	max packet buffers used.
110	40111	UINT32	Radio up time (seconds) MSW
111	40112	UINT32	Radio up time (seconds) LSW
112	40113	UINT16	RF short packets. write 0 to clear stat counters. (R/W firmware 1.17 or later)
113	40114	UINT16	RS485 short packets
114	40115	UINT16	RF Overrun packets
115	40116	UINT16	RS485 Overrun packets
116	40117	UINT16	RF Timeout packets
117	40118	UINT16	RS485 Timeout packets

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offset	point	type	desc
118	40119	UINT16	RF BadChecksum packets
119	40120	UINT16	RS485 BadChecksum packets
120	40121	UINT16	RF RX Good packets
121	40122	UINT16	RS485 RX Good packets
122	40123	UINT16	RF TX packets
123	40124	UINT16	RS485 T Good packets
124	40125	UINT16	RF TX resend packets
125	40126	UINT16	RS485 TX resend packets
126	40127	UINT16	RF RouteChange packets
127	40128	UINT16	RS485 RouteChange packets
128	40129	UINT16	Number of known nodes. (including ourselves)
129	40130	UINT16	Our modbus address
130	40131	UINT16	R9120 Hardware Version (0=rev-A, 1=rev-B, etc)
131	40132	UINT16	Model number bytes 1,2 (4 registers = 8 char string)
132	40133	UINT16	Model number bytes 3,4 (4 registers = 8 char string)
133	40134	UINT16	Model number bytes 5,6 (4 registers = 8 char string)
134	40135	UINT16	Model number bytes 7,8 (4 registers = 8 char string)
135	40136	UINT16	Radio Serial MSW
136	40137	UINT16	Radio Serial LSW
137	40138	UINT16	Radio Firmware
138	40139	UINT16	Radio Type 1=R9120-1(lowpower), 2=R9120-3(highpower) 0=unknown)
139	40140	UINT16	(R/W) Modbus 485 timeout in ms. Default 240ms range 40max to 2000ms. Affects modhopper in master mode only. (max 5000ms in v1.17)
140	40141	UINT16	(R/W) Pulse KYZ flag bitmap. 0x01 = pulse1 kyz mode, 0x02 = p2, etc.
141	40142	UINT16	Reserved
142	40143	UINT16	(R/W) RS485 force master/slave modes. 0=auto/default, 1=force-master, 2=force-slave. (firmware 1.17 or later)
143	40144	UINT16	RS485 master/slave mode status. 0=master, 1=slave. (firmware 1.17 or later)
144	40145	UINT16	RS485 baud rate. 2=9600, 3=19200. (firmware 1.17 or later)
145	40146	UINT16	(R/W) contact closure threshold. in ohms. 100-2550 ohms allowed. (rev-c only, firmware 2.02 or later)
146	40147	UINT16	(R/W) contact closure speed, pulse speed: 0=10Hz/default, 1=50Hz, 2=100Hz, 3=250Hz (firmware 2.02 or later)
147	40148	UINT16	power supply voltage monitor (rev-c only) scale: x100
148	40149	UINT16	pcb temperature monitor (rev-c only) scale: x100
149	40150	UINT16	400MHz RX Good packet count (rev-c only)
150	40151	UINT16	400MHz RX Bad packet count (rev-c only)
151	40152	UINT16	(R/W) minimum packet time, how frequent to save sensor data packets. (10-2550 seconds) (firmware 2.02 or later)
152	40153	UINT16	RS485 serial port option:(firmware 2.05 or later) bits 0-1: 0=N, 1=E, 2=O bit 2: 0=8bit, 1=7bit bit 3: 0=1stop, 1=2stop Note: read only, always returns 8N1

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```
153     40154   UINT16  Radio RF speed mode (0=distance, 1=speed)
                         (rev-c, -5 modhopper only, fw 2.05 or later )

154     40155   UINT16  Reserved

155     40156   UINT16  (R/W) preference lock.  0=unlocked, 1=locked.  when locked,
                        preferences can be changed from 485 port only.
                        (firmware 2.05 or later)

156     40157   UINT16  AES Encryption key present.
                        0=not available, 1=not-active,  2=key-active/256bit.
                        (firmware 2.05 or later, -5 modhopper only)

157     40158   UINT16  Max allowed software RF channel setting.  0=not available.
                        (firmware 2.06 or later)

712     40713   UINT16  bitmap of known radios (16 registers) LSB, MSB order.
                        bit0=n/a, bit1=addr1, etc.
```

Register Functions

Pulse Count: The pulse count is stored as an unsigned 32bit integer. This allows for 2^32 pulses (4.2billion) to be counted before rollover. On Modbus systems that do not allow you to read 32bit values, you can calculate the pulse count as follows:

count = (MSW * 65536) + LSW

or

count = (MSW << 16) | LSW [bit shift high order word by 16 bits and xor against low order word]

Pulse count registers accumulate a total number of pulses received on each pulse input. The pulse count totals always increment and can not be cleared or set to an arbitrary value to prevent tampering. All pulse count totals are stored in non-volatile memory to preserve counts during power failure. The unsigned 32 bit counter values can accumulate up to 4.29 billion (2^32) pulses before rollover.

All 32 bit data point values are encoded in 2 Modbus registers (16bits each). Modbus master systems should always query the A8332-8F2D using a single query to read an entire block of registers. Never use two queries to read one register and then combine the two results into a single 32 bit value. Doing so will allow the pulse count to increment in the middle of the two Modbus queries, and will cause intermittent data readings that are incorrect.

For example, a pulse input has a count of 65534. This is represented as a 32 bit hex number 0x0000FFFE. The first 4 digits are the MSW register, the second 4 digits are the LSW register. The Modbus Master reads the first (MSW) register and gets 0x0000. In between the two readings, the pulse input counts 2 more pulses, making the total 65536 or 0x00010000 in hex. Next the Master reads the second (LSW) register and gets 0x0000. When the two registers are combined, the result is 0x00000000. The proper way to handle this situation is to simply read both registers in a single Modbus query.

Instantaneous Pulse Rate: The pulse rate values for instantaneous, min and max rates are calculated based on the time between arriving pulses. For example, if InstPulse1 = 30, and inst pulse count size is 5, then the average rate for the last 5 pulses is 6 seconds per pulse. To convert the register values (in seconds) to a rate value, use the following formula.

RatePerHour = (N * 60 * 60 / Inst_Register)

Where InstRegister is any of the 6 register values 4 through 9. N is the instantaneous pulse count size at offset 10.

Min/Max pulse rate: These 4 registers are calculated from the instantaneous pulse rate. These latching registers are updated whenever the minimum or maximum rate fields are exceeded by the instantaneous rate. These 4 registers may be cleared by writing a zero to the register. Writing to one min/max register clears all four min/max registers.

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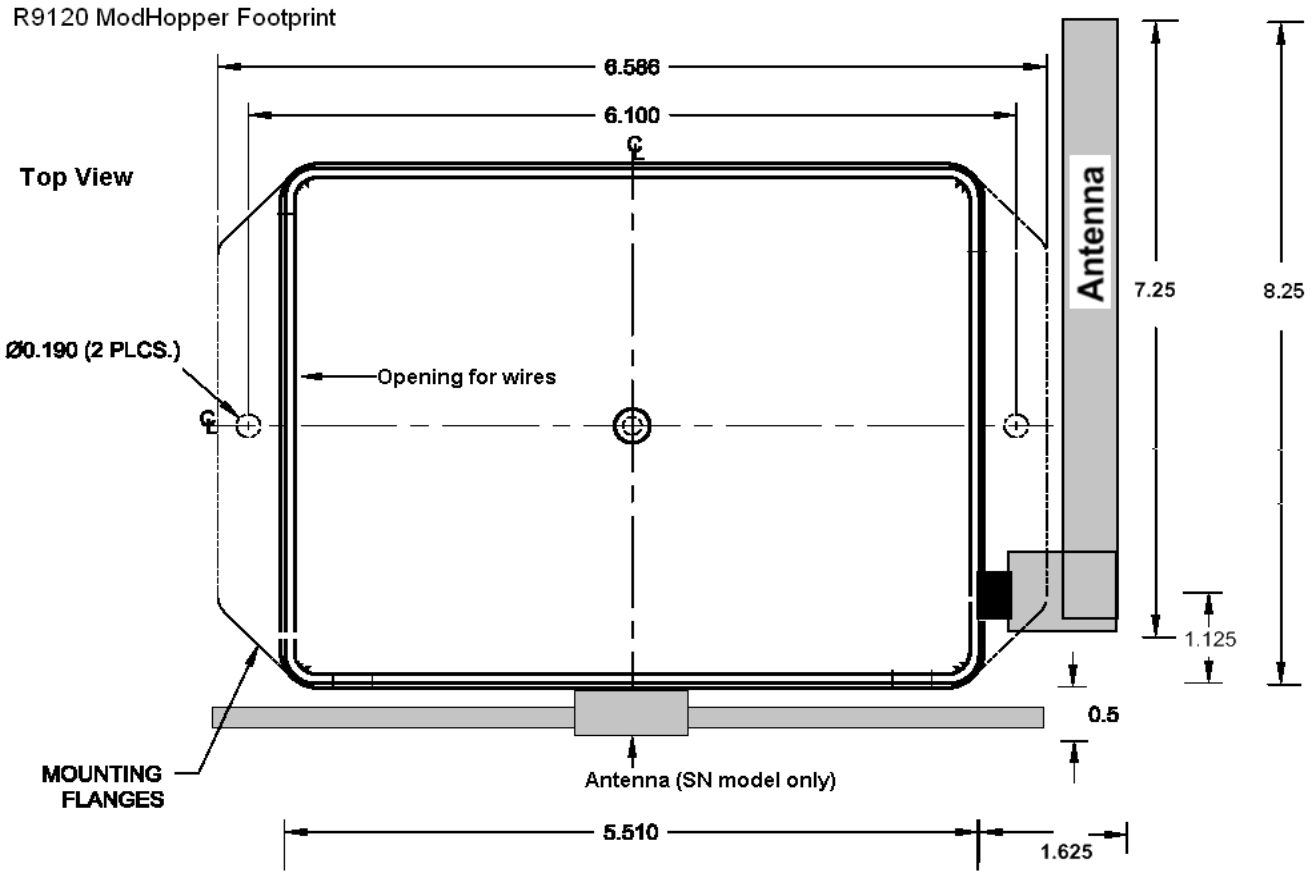
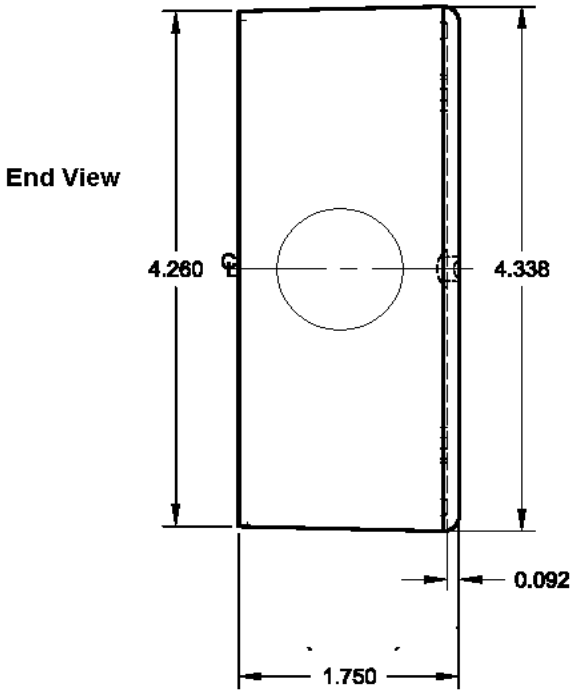
Mechanical Drawings

The R9120 must be wall mounted, or mounted inside an appropriate enclosure rated for the weather, location, and electrical components located inside it. The R9120 mounting holes are detailed below.





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Firmware Update

From time to time, Obvius may release firmware updates with additional features and system changes. To find out what firmware your ModHopper has installed, read the firmware version register with a Modbus utility, or use the "Advanced configuration" page in the AcquiSuite setup menu. Firmware update files may be obtained from Obvius technical support.

The firmware update process requires an RS232 serial port and a windows computer to run the firmware update utility. Before starting this process, verify your computer has a serial port available. You may need to deactivate other software such as the palm pilot utility or ups monitor software. USB connected serial ports may be used however you may need to reduce the baud rate if you receive errors updating the firmware.

To update the firmware, use the following procedure.

Step 1: Install the Philips LPC2000 software as provided by Obvius.

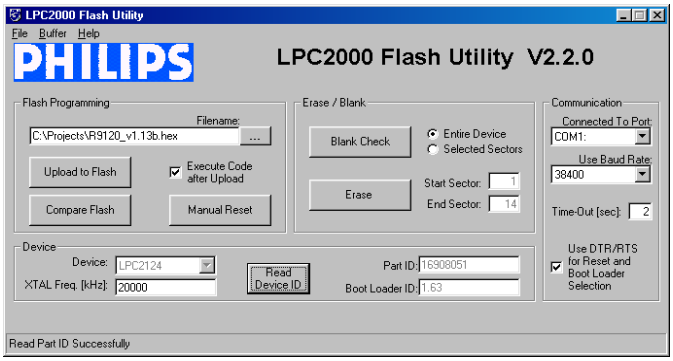
Step 2: Remove power, RS485 and pulse inputs from the ModHopper. Power can be disconnected by removing the screw terminal or plug from the ModHopper power connection socket.

Step 3: Set the following dip switches:
Prog Enable = on
485/232 = on

Step 4: Attach the ModHopper to your computer with an RS232 serial cable. The ModHopper programming connector is the 9 pin RS232 connector on the top of the device.

Step 5: Power up the ModHopper. The Green Alive LED should light up and solid.

Step 6: Run the LPC2000 Flash Utility. The following screen will be displayed.



Step 7: Set the following communications options:
COM1 or COM2 depending on your computer serial port.
Use baud rate: 38400 or slower.
Check "Use DTR/RTS for Reset"
XTAL Freq[kHz] = 14745

Step 8: Click the "Read Device ID" button. The PartID and BootLoaderID fields will be shown if successful. Also, the "Device" dropdown menu should switch to LPC2131. The bottom of the window will display "Read Part ID Successfully."

Step 9: Click the "Filename" "..." button. A dialog box will appear. Locate and select the ModHopper firmware image file. In the example above, this is named "R9120_revC_v2.04.hex".

Step 10: Click the "Erase" button. This will remove the existing firmware from the ModHopper device.

Step 11: Click the "Upload to Flash" button. The firmware update will start, and a blue progress bar will be shown across the bottom of the screen. While the upload is in progress, the green Alive LED on the ModHopper will stay on solid.

Step 12: when the update is complete, disconnect power from the ModHopper. Remove the RS232 serial cable. Turn off the ProgEnable, and 485/232 switches.

Step 13: Re-attach the RS485 data and pulse wire connections. Power up the ModHopper. The new firmware should now operate. To confirm the new firmware is installed, use the AcquiSuite device details page, click the "configure" button, and then the "Advanced" button. The firmware version number will be displayed on the lower right side of the advanced details page.

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